Addendum

to

Exposure Investigation

for

Herculaneum Lead Smelter

Herculaneum, Jefferson County, Missouri

EPA FACILITY ID: MOD006266373

December 2, 2002

U. S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Exposure Investigations Section
Atlanta, Georgia 30333

Background

On September 10, 2001, the Agency for Toxic Substances and Disease Registry (ATSDR) released a report for an Exposure Investigation (EI) conducted for the Doe Run Smelter in Herculaneum, Missouri [1]. This investigation focused on identifying sources of lead exposure in children who had elevated blood lead concentrations.

With the assistance of the Missouri Department of Health (MDOH), ATSDR recruited two families for the EI. The families met the following criteria:

(1) The family lived in a house that was located within a one-half mile radius of the smelter.
(2) One or more children aged 6 years old or less had lived at the house for his/her entire life.
(3) Recent testing showed that a child in the family had a blood lead level of 15 μg/dL or higher.

ATSDR collected biological samples (blood, urine) from the family members and environmental samples (water, soil, dust, air, paint) from their house. These samples were analyzed for lead and stable lead isotopes. The results of these analyses were used to identify possible sources of lead exposure in the children.

ATSDR concluded that:

(1) Lead contamination was detected in ambient air particulates, dust on window sills, surface soil, and house dust. Lead from these sources is likely contributing to the elevated blood lead concentrations detected in the young children.

(2) Lead in paint and water do not appear to be a significant source of lead exposure in the children with elevated blood lead concentrations.

The Environmental Protection Agency and the Missouri Department of Natural Resources have signed an Administrative Order of Consent (AOC) with the Doe Run Company to control and cleanup environmental lead contamination. The AOC requires new controls on air emissions, remediation of lead contaminated residential yards, and investigation and stabilization of a contaminated slag pile located in the Mississippi River flood plain [2]. In addition, the Missouri Department of Health and Senior Services continues to screen for lead paint in homes with young children.

Doe Run Environmental Sampling

Since the EI was conducted, the Doe Run Company purchased one of the houses (House 1) that was included in ATSDR's investigation. Representatives of Doe Run subsequently identified additional sources of lead paint in the house that ATSDR was not aware of at the time of its investigation. Doe Run collected samples of these paint sources and had them analyzed for stable lead isotopes. In addition, Doe Run collected samples of ore, bag house dust, slag, electrostatic precipitator dust, sinter fines, and finished lead from the smelter, which were also

analyzed for stable lead isotopes. The results of these analyses, which are attached as Appendix A, were provided to ATSDR in July 2002.

Discussion

Smelter and Environmental Sampling

The Doe Run Smelter obtains a lead ore concentrate from mines in Missouri that mine ore from a geological deposit known as the Vibirnum Trend. Lead from these mines is characterized by having a high ratio of lead 206 to lead 204 [3]. As indicated by the data below, lead from other geological sources in the United States typically has a lower 206/204 ratio [3].

	206/204 ratio
Missouri	20.5 - 21.5
Colorado	17.7
Utah	17.6 - 20.0
Idaho	16.3
California, Shasta	17.9
California, Kernville	19.5

This high 206/204 ratio of lead from the Viburnum Trend allows it to be distinguished from other geological lead deposits in the United States. In the lead ore samples from three mines in Missouri that were analyzed by Doe Run, the average 206/204 ratio was 20.89. This ratio was similar to the average ratio of 20.93 for samples of bag house dust, slag, electrostatic precipitator dust, and sinter fines that were collected from the smelter. Finished lead also had a similar ratio of 20.86.

In July 2001, ATSDR collected samples of outdoor air, window sill dust, house dust, and soil from House 1. The 206/204 lead ratios in the environmental samples from this house were as follows:

Air	20.64
Window sill dust	20.54
House dust	20.38
Soil	20.36

The 206/204 ratios in these samples were high, although they were slightly below the ratios in ore, dust, and slag samples from the Doe Run smelter. The high 206/204 ratios in the residential environmental samples provides evidence that lead from Doe Run sources is making a major contribution to their lead content. The slightly lower 206/204 ratios in the environmental samples (as compared to the Doe Run samples) could be due to a minor contribution to their lead content from other environmental background sources of lead with lower 206/204 ratios.

Previous investigations in Herculaneum have concluded that lead emissions from the Doe Run Smelter have contaminated air and residential soil in the town [4, 5]. Between 1991 and 1999, the Doe Run Company replaced lead-contaminated soil in about 120 residential yards, and additional properties are currently being remediated. It was reported that the replacement soil for the excavated yards averaged 14 ppm lead [6].

In 1999, soil in the yard from House 1 was excavated and replaced with clean soil. In July 2001, ATSDR collected soil samples from a play area in the yard and along the drip line of the house. The lead concentration of these soil samples was 342 ppm and 999 ppm, respectively. The elevated lead concentrations in these soil samples indicate that the replacement soil has become recontaminated. Furthermore, as discussed above, the elevated lead 206/204 ratio in the soil samples suggests that lead from the Doe Run smelter is a major source of this lead recontamination.

Lead paint sampling

Doe Run provided ATSDR with lead isotopic ratios for lead-containing paint samples in the house. The lead concentrations in the paint samples were not provided. The lead isotopic ratio in 11 paint samples ranged from 18.503 to 21.810. Many of these paint samples were collected from locations that would have been inaccessible to the children (e.g.; above a drop ceiling, baseboard molding of closet in parent's bedroom).

In the paint samples analyzed by Doe Run, one sample had a lead 206/204 isotopic ratio (20.172) that is very close to the lead isotopic ratios in blood samples from young children in the house (20.14 and 20.17). This paint sample was collected from the front door frame of the house. This paint had some fine cracks (alligatoring), but it was intact and showed no signs of chipping or flaking. In addition, the family reported that they rarely used the front door, so mechanical abrasion of the door frame surfaces would be minimal. Therefore, it does not appear that paint from this doorway was a major contributor to lead contamination inside the house. Nevertheless, because of the similarity in the lead isotopic ratios in the paint and blood samples, ATSDR can not rule out the possibility that lead from this paint is making a minor contribution to the children's total lead exposure.

Conclusions

(1) Lead contamination from the Doe Run Smelter has made a substantial contribution to lead contamination in air, window sill dust, and house dust from House 1. Lead from smelter emissions is the most likely source of lead recontamination of soil in the yard of House 1.

(2) The most likely environmental source of lead exposure in the children from House 1 was lead from air, dust, and soil. It does not appear that lead from paint in the house was a major source of lead exposure. However, ATSDR can not rule out the possibility that lead from paint in the house made a minor contribution to the children's total lead exposure.

Recommendations

(1) Implement actions to minimize children's exposures to environmental lead contamination, including lead-containing paint.

(2) Implement actions to reduce air lead emissions from the facility.

(3) Encourage regular blood lead testing in all young children (≤ 6 years old) who live in the vicinity of the smelter.

Report prepared by:

Kenneth G. Orloff, Ph.D, DABT
Senior Toxicologist
Exposure Investigation and Consultation Branch
Division of Health Assessment and Consultation

References

(1) Agency for Toxic Substances and Disease Registry; Health Consultation: Exposure Investigation for Herculaneum Lead Smelter Site; September 14, 2002.

(2) Missouri Department of Natural Resources; Herculaneum Lead Contamination; http://www.dnr.state.mo.us/env/herc.htm; November 2002.

(3) M. B. Rabinowitz; Stable isotopes of lead for source identification; Clinical Toxicology 33(6) 649-655 (1995).

(4) Missouri Department of Natural Resources; Preliminary Assessment Report: Herculaneum Lead Smelter Site; March 30, 1999.

(5) U. S. Environmental Protection Agency; Administrative Order of Consent; Docket No. RCRA-7-2000-0018; September 29, 2000.

(6) Doe Run Company; Long-term Monitoring and Maintenance Plan for Lead Redeposition; July 30, 2001.

Appendix A